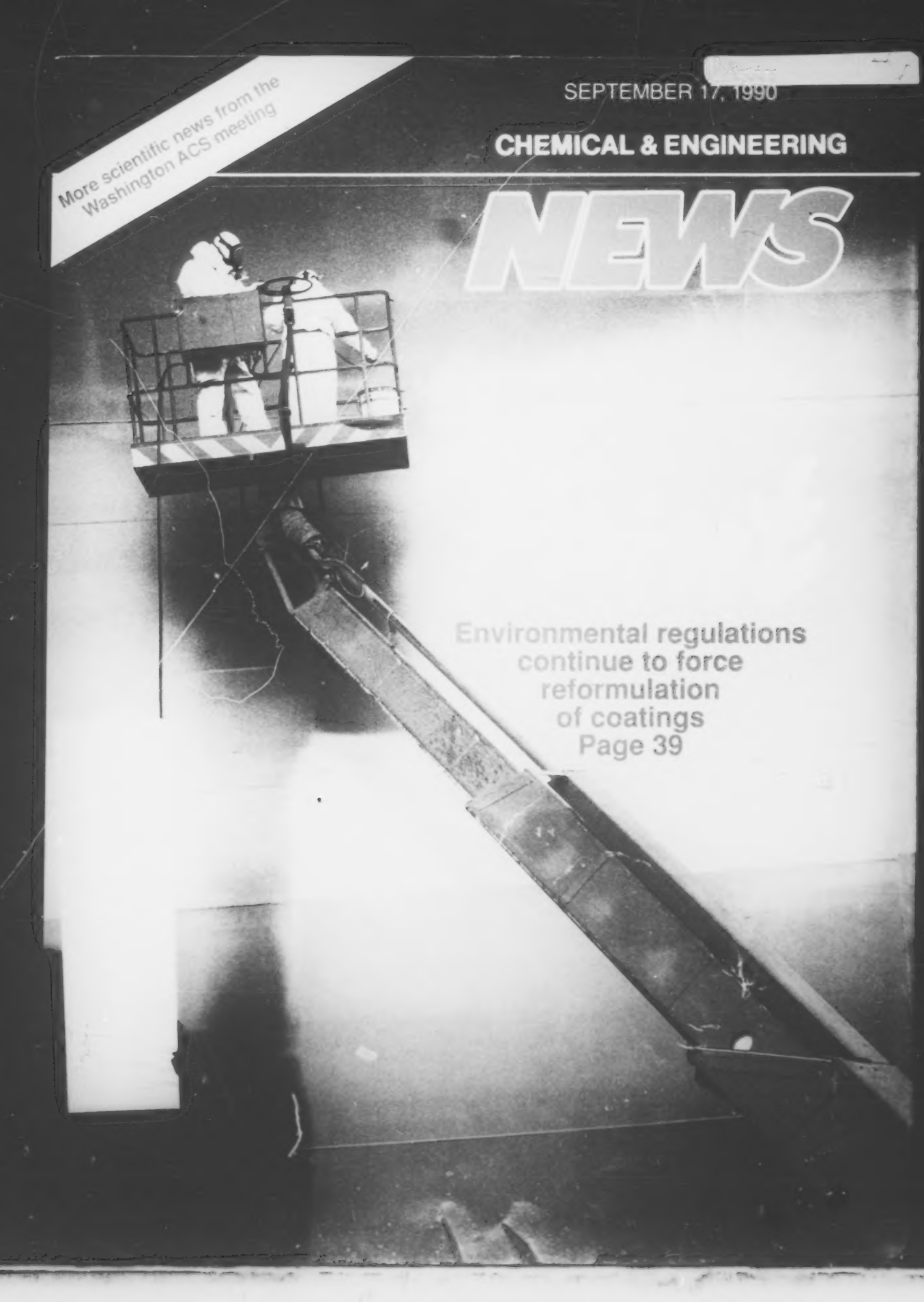
SEPTEMBER 17, 1990

CHEMICAL & ENGINEERING

NEWS

More scientific news from the Washington ACS meeting



Environmental regulations continue to force reformulation of coatings
Page 39

CHEMICAL & ENGINEERING
NEWS
SEPTEMBER 17, 1990

Volume 68, Number 38
C&ENEAR 68 (38) 1-92
ISSN 0009-2347

News of the Week

■ **Massachusetts Institute of Technology appeals NSF decision to award National High Magnetic Field Laboratory to a Florida State University consortium.** Page 4

■ **Regional Environmental Center for Central & Eastern Europe in Budapest opens its doors, begins efforts to reverse region's environmental damage.** Page 5

■ **Threat posed by Iraqi chemical weapons has been exaggerated by the press, according to panelists at recent Congressional briefing organized by the American Association for the Advancement of Science.** Page 5

■ **Two biotech firms caught in patent conflict over single-chain antigen-binding proteins.** Page 6

■ **House subcommittee report calls for new laws, regulations to deal with scientific misconduct, conflicts of interest in biomedical research.** Page 6

Cover: Workers spray paint on container ship. Photo courtesy of Courtaulds Coatings

Letters 2

Concentrates

Business 7
Government 16
Science/Technology 20

The Departments

Software/Database Update 36
Newscripts 92

Business

Tosoh Corp. is bolstering its petrochemical operations; catalog approach to technology licensing will be used at fair near London. **Page 13**

Government

Changes in risk assessment management of problem chemicals called for; policies must be devised to prevent the U.S. from losing access to technology developed abroad; draft treaty on harmonizing world patent law presents some hard decisions for the U.S. **Page 17**

Science/Technology

From the Washington meeting: Human genome project presents challenge, but also opportunity, to analytical chemistry community; study links radon levels in water supply of private homes to higher cancer risk; recent fluoride bioassay study questioned as too lenient; advances made in approaches to engineering enzyme activity; new high-analysis phosphate fertilizer process could also cut production of waste products; fire-extinguishing halons are proving hard to replace; compact, benchtop LC/MS from Extrel introduced; Noxso process to undergo major stack-gas cleanup trial in Ohio; organic vapors change color of Pt-Pd salts. **Page 21**

Books

"Managing Creativity in Science and Hi-Tech" by Ronald Kay misses the mark in focus on creativity. **Page 73**

ACS News

ACS Council adopted two bylaw amendments, among other actions, at its meeting late last month in Washington; also, numerous local sections received awards for National Chemistry Week programs. **Page 75**

Product Report

Paint industry's 1989 shipments' value of $11.6 billion hits new high during a period when marine and other specialty coatings makers are reformulating products to meet environmental concerns. **Page 39**

Chemical & Engineering News
1155—16th St., N.W., Washington, D.C. 20036
Editor: Michael Heylin
Assistant Managing Editors: David M. Kiefer, James H. Stenger, Janice R. Long, Donald J. Soisson, William J. Storck. **News Editor:** Wilbert C. Lepkowski
Staff Editor: Ernest L. Carpenter
Senior Editors: New York: Earl V. Anderson, Stephen C. Stinson; Chicago: Joseph Haggin; London: Patricia L. Layman; Washington: Doron Dagani, Lois R. Ember, Bette Hileman, Rebecca L. Rawls, Pamela S. Zurer
Associate Editors: Stuart A. Borman, Mairin B. Brennan, Ann Marie Menting, Richard J. Seltzer
Service Departments Editor: Dolores Miner
Editing Services: Anne Riesberg (Head), Arlene Goldberg-Gist (Editorial Assistant), Patricia Oates (Administrative Assistant)
News Bureaus: Northeast News Bureau: (201) 906-8300 Marc S. Reisch (Associate Editor), Ann M. Thayer (Associate Editor), Rachel Eskenazi (Administrative Assistant). Chicago: (708) 256-4143 Ward Worthy (Head). Houston: (713) 973-8161 Bruce F. Greek (Head), Susan J. Ainsworth, (Associate Editor). Washington: (202) 872-4495 David J. Hanson (Head). West Coast: (415) 653-36.0 Rudy M. Baum (Head). **Foreign Bureau:** London: (01) 540-0414 Dermot A. O'Sullivan (Head)
Graphics and Production: Leroy Corcoran (Head). Alan Kahan (Art Director). Barbara Fryer (Production/Art Director). Linda Mattingly (Staff Artist). Diane Kelly (Costing)
Business Manager: Arthur Poulos
Circulation Director: David Schulbaum
ADVISORY BOARD: Dexter F. Baker, George M. Bodner, Will D. Carpenter, Renée G. Ford, Ethan C. Galloway, Louis J. Glunz, Harry S. Hertz, Christopher T. Hill, Kendall N. Houk, Cynthia A. Maryanoff, Linda B. McGown, C. Bradley Moore, Koji Nakanishi, George B. Rathmann, David A. Shirley, Robert M. Simon, Peter H. Spitz, Barry M. Trost
Published by
AMERICAN CHEMICAL SOCIETY
(202) 872-4600; TDD (202) 872-8733
John K Crum, Executive Director
Robert H. Marks, Director, Publications Division
PUBLISHING BOARD: Jean'ne M. Shreeve *(Chairman); Board of Directors Chairman:* Joseph A. Dixon; *President:* Paul G. Gassman; Richard L. Deming; William P. Jencks; Gary J. Long; and Louis D. Quin

© Copyright 1990, American Chemical Society

Subscription & Member Record Service: Send all new and renewal subscriptions with payments to: ACS, Dept. L-0011, Columbus, Ohio 43268-0011. Correspondence and telephone calls for changes of address, claims for missing issues, subscription orders, status of records and accounts should be directed to: Manager, Member & Subscriber Services, ACS, P.O. Box 3337, Columbus, Ohio 43210; (800) 333-9511 or (614) 447-3776.

For changes of address, include both old and new addresses with ZIP code numbers and mailing label from a recent issue. Allow four weeks for change to become effective. Claims for missing numbers will not be allowed if loss was due to failure of notice of change of address to be received in the time specified; if claim is dated (a) North America: more than 90 days beyond issue date, (b) all other foreign; more than one year beyond issue date; or if the reason given is "missing from files."

Subscription Rates 1990. Printed editions: nonmembers U.S. 1 yr. $60, 2 yr. $108, outside U.S. 1 yr. $93, 2 yr. $174. Air freight rates available on request. Rates above do not apply to nonmember subscribers in Japan, who must enter subscription orders with Maruzen Co. Ltd., 3-10 Nihonbashi 2-chome, Chuo-ku, Tokyo 103, Japan. Tel: (03) 272-7211. Single copies: Current $9.00. Rates for back issues and volumes are available from Microforms & Back Issues Office, ACS, 1155—16th St., N.W., Washington, D.C. 20036. Back and current issues available on microfilm and microfiche. Rates on request from Microform Program, ACS.

Chemical & Engineering News (ISSN 0009-2347) is published weekly except for the last week in December by the American Chemical Society at 1155—16th St., N.W., Washington, D.C. 20036. Second-class postage paid at Washington, D.C., and additional mailing offices. POSTMASTER: Send address changes to Chemical & Engineering News, Membership & Subscription Services, P.O. Box 3337, Columbus, Ohio 43210. ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications.

Advertising Management
CENTCOM LTD.
(For list of offices see page 91)

LETTERS

Nonlinear optical materials

Your article on nonlinear optical materials (C&EN, June 11, page 21) was timely and informative. Due to the rapid progress in this field, the statement, "Currently, scientists know of no way to prepare small particles of III-V semiconductors in solution," is no longer true. At the spring Materials Research Society meeting in San Francisco (April 16–21), M. A. Olshavsky, A. N. Goldstein, and A. P. Alivisatos reported the preparation of GaAs nanocrystals, which are soluble in quinoline. The particles were prepared using a reaction and methodology developed by Richard L. Wells and research colleagues.

A. Paul Alivisatos
Assistant Professor
Department of Chemistry
University of California, Berkeley
Richard L. Wells
Professor, Department of Chemistry, Duke University

Structure of dynemicin

The article by Stephen Stinson on dynemicin, "New Anticancer Antibiotic Acts through Diradical Rearrangement" (C&EN, May 28, page 22), is misleading on a few points. Perhaps there is a natural prejudice toward the *Journal of the American Chemical Society*, but it should be noted that the structure of dynemicin was first reported almost a year ago (by the Bristol/Japan and Cornell groups) in the *Journal of Antibiotics* [**92**, 1449 (1989)]. When the structural relation to the other ene-diyne toxins and to bioreductive activation mechanisms is appreciated, the mechanism of action follows in a reasonably obvious way. This was first proposed in print earlier this year [*Tetrahedron Lett.*, 1521 (1990)] by myself and coworkers J. Gallagher and D. Cohen. Molecular mechanics calculations were used to verify the reasonableness of the mechanism. The *JACS* paper [**112**, 3716 (1990)] from the Bristol/Cornell effort, which was the focus of the C&EN article, beautifully corroborates the hypothesis with full structural details. It should also be noted that one issue later in *JACS*, a more elaborate computational analysis of the mode of action of dynemicin was presented [Snyder, J. P., Tipsword, G. E., *J. Am. Chem. Soc.*, **112**, 4040 (1990)].

Separating hypothesis from experimental fact was not clear in the statement that for calicheamicin/esperimicin "workers have found that sugar molecules attached to them are very specific for binding to DNA." That is an exciting and reasonable hypothesis with far-reaching implications. However, although it has been established that these toxins react directly with DNA oligomers in vitro, there is as yet no experimental evidence that establishes interaction of the sugar portion with DNA.

M. F. Semmelhack
Professor, Department of Chemistry, Princeton University

Jobs for chemists?

Your editorial on an opportunity for chemists (C&EN, June 11, page 3) repeats the often heard refrain that we are not training enough American scientists. The major reason students are not studying for a degree in the sciences is simply because there are few well-paying jobs available.

We have had a number of postdoctoral candidates at our Department of Agriculture laboratory (USDA-ARS, Appalachian Fruit Research Station, Kearneysville, W.Va.). After working with us for two years, they look for a permanent job. It is typical for them to write to 50 to 100 schools or laboratories looking for work. On the rare occasion they get a reply, the salary is in the mid-20s. My colleagues at other facilities have indicated that their students or postdocs are having similar experiences. Few are able to make a living in science.

What is the point of studying for a career that does not exist? At the present time the smart kids are sticking to the basics: medicine, law, engineering, and business. Why spend $100,000 on a B.S. degree and work for starvation wages in graduate school only to get a degree in a field without jobs? I would like to think that if you are smart enough to get a Ph.D. in something, you would be smart enough to see if you could earn a living at it. The word gets around.

These calls for more money to train future chemists or other scientists are

Corrections

- Aug. 27, page 3: In the letter on Avogadro's number, the definition of atomic mass unit (u) should read u = $^1/_{12}$, not $^1/_2$; the mole of lawyers should be 4.9×10^{25} kg, not $4 \times 9 \times 10^{25}$ kg.
- Sept. 3, page 3: In the letter on video terminal hazards, the reference in the last paragraph to an article in the *New Yorker* should be June 26, 1989, not 1990.

Marine paint makers strive to meet environmental concerns

Glidden photo

Dow Chemical photo

Specialty paints (above) serve to protect fiberglass hulls. Technician applies powder coating to test panels

Marc S. Reisch,
C&EN Northeast News Bureau

The value of paint shipments in 1989 reached a new high of $11.6 billion. However, paint shipment volumes declined 2% from the previous year, dipping to 1.04 billion gal.

An analysis of government statistics of the paints and coatings industry follows on this page. These statistics show that the value of shipments and cost per gallon of paint sold increased in all categories. But actual shipment volume rose only slightly for architectural and special-purpose coatings and actually declined in product coatings.

Manufacturers of marine coatings—the focus this year of C&EN's examination of a high-value-added component of the product coatings and special-purpose maintenance category—are under environmental pressure like their counterparts in the architectural category examined in last year's report (C&EN, Oct. 30, 1989, page 29). Increasingly, manufacturers are reformulating to reduce smog-producing volatile organic compounds (VOCs), and reformulating with water-borne coatings where possible. In addition, manufacturers of paints used to protect oceangoing vessel hulls below the waterline are grappling with legislative limitations existing or pending that would limit or ban the use of organotin polymers that discourage barnacle growth. A discussion of how paint makers are grappling with these new limitations as well as those posed by the eventual phase-out of chlorinated rubber in marine paints because of their ozone depletion potential begins on page 43.

Even as liquid coating manufacturers reformulate to increase environmental acceptability, powder coatings manufacturers say their pollution-free materials are just beginning to achieve their potential. Powders are 100% solid coatings that have neither VOC problems nor waste disposal problems. In an examination that begins on page 54, manufacturers and material suppliers discuss the growth of powder coatings as well as improvements in technology that may expand the substrates to which powder may be applied from the metal substrates coated today.

Liquid coatings, though, are still the most versatile coatings available. To deal with the waste generated when a significant percentage of spray solids do not coat a part, original equipment manufacturers (OEM), particularly in the automotive business, are using more sophisticated chemical systems to capture and separate paint solids for reuse. Beginning on page 64, manufacturers of paint detackification systems discuss work in the reuse of dried paint sludge as a cement kiln additive or as a filler in sound-deadening paint and fillers in adhesives and sealants.

Shipments declined 2% last year

As the U.S. economy slowed in 1989, especially during the second half of the year, U.S. paint makers shipped only slightly more than 1 billion gal of paints and coatings, according to the most recent data from the Department of Commerce. That figure marks an almost 2% decline in volume compared with 1988 and puts industry shipments below the 1987 level.

The value of industry shipments continued to rise in 1989, but the increase could not have resulted in big profits for paint makers. Although the Department of Commerce figures show that the value of 1989

Architectural coatings lead in shipments . . .
Architectural coatings 51%
Product coatings[a] 33%
Special-purpose coatings 16%
Total 1989 shipments = 1.04 billion gal
. . . and tally highest in value of shipments
Architectural coatings 41%
Product coatings[a] 38%
Special-purpose coatings 21%
Total 1989 value = $11.6 billion
a As reported by original equipment manufacturers.
Source: Bureau of the Census

shipments rose 7.9% from 1988 to $11.6 billion, paint material prices continued to soar—up almost 12% during the same period. Even if inflation and increased labor and shipping costs were not a factor (and they were), it was not a good year for the paint industry overall and could only have encouraged the industry trend toward consolidation.

Preliminary 1990 government data do not indicate this year will be much better than 1989. Although paint shipments for the first six months of this year improved marginally to 530 million gal, the value of shipments increased 5.8% in the same period to $6.1 billion. But just as paint material prices rose in 1989, squeezing profits, they did so again in the first six months of this year when the Department of Labor's statistics indicate paint material prices increased 6.4%.

In addition to pressures paint manufacturers are experiencing because of increasing raw material costs, they continue to feel the pressure to reformulate coatings in response to regulatory demands for a reduction of VOCs that may be emitted as liquid coatings dry. And they cannot easily pass along price increases in a very competitive market where about 900 paint manufacturers compete for much of the same business.

With margins under so much pressure, it is not surprising to see a well-known paint maker the size of DeSoto sell its huge paint business. Though an unfriendly takeover bid by a New York City investment group, Sutton Holdings, nudged DeSoto to sell its paint interests, a sluggish architectural and industrial paint market had limited DeSoto's profitability. In July, DeSoto agreed to sell its architectural coatings assets to Sherwin Williams for $80 million. Following that announcement, Rohm & Haas said it would purchase a former DeSoto latex emulsion and resin plant that Sherwin Williams had acquired from DeSoto. DeSoto also agreed to sell its industrial coatings business to Courtaulds for $135 million. Courtaulds, in turn, arranged to sell Valspar Desoto's coil, appliance, specialty, and packaging coatings business for $46 million, and sold to DSM Resins, the radiation cure and optical fiber coatings businesses it operated with DeSoto in a joint venture, for an undisclosed sum. Courtaulds retained the aerospace coatings business.

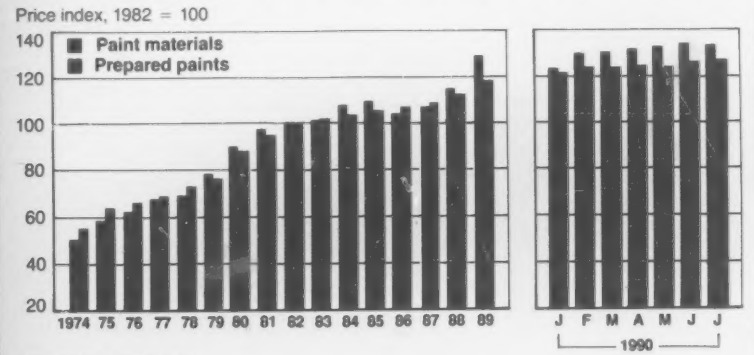
More evidence of cost pressure affecting paint formulators during the current year was in the Environmental Protection Agency's announcement early in July that it would ban the use of mercury in interior architectural paints. The lesson here is that the shift to water-borne formulations from solvent paints is not without environmental and health risks—the water-borne formulas require a biocide such as mercury. Formulators who had not already done so had to find alternatives, such as cuprous oxide and organotin polymers.

Early in June paint formulators were put on notice that at least one consumer group had targeted a phaseout of methyl chloroform, also known as 1,1,1-trichloroethane, well in advance of industry expectations. The Washington, D.C.-based Natural Resources Defense Council called for a consumer boycott of household products containing the solvent in order to force industry to cease use of the solvent widely acknowledged in government and industrial circles as a chemical capable of depleting the atmospheric ozone layer. Though chlorofluorocarbons 11 and 12 are more potent depleters of atmospheric ozone, and also more widely used, paint formulators must acknowledge them as another potential problem. Fortunately, trichloroethane is not a widely used coatings solvent. Industry sources say U.S. coatings formulators use about 35 million lb of trichloroethane annually. The Freedonia Group, a Cleveland-based consulting firm, estimated in its Paint, Polymers & Chemical report, that the coatings industry used 3.4 billion lb of solvents in 1988. Trichloroethane use is therefore only 1% of all solvent use in coatings.

Trichloroethane manufacturers such as Dow Chemical and PPG Industries agree that a timetable to replace the product will have to be put into place. Up until now, trichloroethane has proved valuable in replacing smog-producing solvents. However, manufacturers now must spend the money to reformulate and produce coatings that contribute very little to atmospheric smog formation without the aid of trichloroethane or be forced to withdraw products from highly regulated markets.

A 1989 profile of this dynamic if not always robust industry, based on Bureau of Census figures, shows that architectural coatings, which include both interior and exterior house paints, make up slightly more than half of all paint sold in the U.S. Product coatings for the OEM market, which includes automotive and appliance coatings, account for some 33% of U.S. paint volume. And special-purpose coatings make up about 16% of total paint shipments. This category includes large-volume maintenance items, automotive refinishing, and coil coatings.

Materials price hikes still outpace those of prepared paint



Source: Department of Labor

Shipments of architectural coatings in 1989 increased only marginally from the previous year to 533 million gal. The value of those shipments, however, rose 8.2% from 1988 to $4.73 billion, and the unit price per gallon rose 7.9% to $8.88. Architectural coatings volume did not decline despite the lag in new housing starts, as moderate prices continued to afford consumers the ability to redecorate with a modest investment in paint, even as they may be delaying purchases of more costly durable goods such as appliances and automobiles.

Product shipments for the OEM sector, however, declined 7.4% to 337 million gal, even as the government's estimates for 1988 shipments were revised downward to 364 million gal. The value of shipments rose in 1989 to $4.35 billion, up 7.1% from the previous year. Unit prices per gallon increased nearly 16% to $12.91. A portion of that increase in shipment value and unit price continues to be related to the cost of reformulated higher solids, paints OEM manufacturers must increasingly use to meet ever more stringent VOC limits.

Special-purpose coatings shipments and value both increased in 1989. According to the government figures, special-purpose coatings shipments increased 5% from 1988 to 167 million gal. The value of those shipments rose 8.8% to $2.48 billion, and the unit price per gallon rose 3.8% to $14.88.

According to the Department of Labor, indexes covering both paint materials and prepared paint show that prices continued to rise in the first six months of 1990. In that period, the index for paint materials prices rose 6.4% from last year's first six months to 132.5 (1982 = 100). While prices of most paint material categories remained steady or declined over the six-month period, solvent prices rose 20% since January from an index of 74.9 to 90.2 in June. However, emphasizing the cyclical nature of the solvent market is the fact that the June solvent index price was still 10% lower than it was in June 1989.

Titanium dioxide prices, which rose steadily last year during the first six months, were actually 1% lower in this year's first half. Prepared paint prices continue to lag behind increases in raw material prices, just as they did during the first six months of last year. The Department of Labor's index for prepared paint prices rose only 2% between January and June of this year to an index of 124.7. The lag continues to reflect manufacturers' reluctance to raise prices too rapidly for fear of losing share in a competitive market.

On an average annual basis, paint materials costs increased only 6.5% between 1974 and 1989. Prepared

Looking for a safer, more powerful solvent?

Look here first.

DMSO (dimethyl sulfoxide) is a powerful, polar, aprotic solvent. It can increase yields and can be recycled easily.

DMSO is also one of the safest industrial solvents you can use. Its toxicity parameters are similar to those for glycerine or ethanol.

But, will DMSO solve your solvent problems? Gaylord can help you find the answer. We have the world's largest data base on DMSO.

Call 800-426-6620. We'll send technical data to get you started.

GAYLORD CHEMICAL CORPORATION

P.O. Box 1209
Slidell, LA 70459-1209

CIRCLE 25 ON READER SERVICE CARD

paint costs rose 5.3% over the same period. Clearly this is an industry that depends overall on volume sales rather than price increases to maintain profitability. And where price increases barely keep pace with inflation, manufacturers must survive by gaining market share and improving manufacturing efficiencies.

Though the Census Bureau reports actual shipments of paint declined in 1989, the Department of Labor reports total employment in the paint industry increased. The number of production and nonproduction paint industry workers rose 2.6% last year to 63,400 compared with a revised 61,800 for 1988. If the Department of Labor does not revise its industry employment estimate for 1989, the paint industry will have produced 98 million gal more paint than when Labor last estimated the industry employed 63,500 workers in 1985.

The number of both production and nonproduction workers increased between 1988 and 1989. Nonproduction employees of paint firms rose 0.3% in 1989 to 31,300; production employees increased 4.9%. However, between 1980 and 1989, employment of production employees declined 2.4% to 32,100. The level of nonproduction employees decreased 2.8% during the same period.

Marine paints: durable yet gentle to environment

Marine coatings comprise a specialty segment of the world paint market. Paints supplied to this market must survive under the harshest environmental conditions and so suppliers must formulate the most durable coatings available. But recently these high-value-added paints costing between $100 and $200 a gal have come under many of the same pressures that have forced other industrial paint makers to reformulate paints to lower VOC levels. In addition, because they are formulated to deter the formation of barnacles, organotin compounds used as the primary antifouling ingredient in paints applied to ship hulls below the waterline are implicated in the destruction of marine life. Also, concern over the ozone-depleting potential in the manufacture of chlorinated rubber compounds used in deck and surface shipboard applications has meant that paint manufacturers have had to develop alternatives.

According to Mark Davies, marine marketing director of Courtaulds Coatings, marine coatings represent a $1 billion worldwide market. Davies says his company holds in excess of 30% of the marine coatings market where Courtaulds Coatings is best known by its International label. There are three key segments of the marine market, he says: new ship paints, maintenance and repair paints applied to ships in dry dock, and sea store paints that crews apply to vessels at sea. Davies also outlines three major customer segments: shipping companies who own fleets and manage the fleets themselves, fleet management companies, and shipyards.

Major shipbuilding countries that build and paint new oceangoing vessels are South Korea and Japan, and together with China and Taiwan, they hold about 60% of the ship tonnage on order, says Davies. Other major shipbuilding countries are Yugoslavia, Poland, Denmark, West Germany, Italy, Spain, and Brazil. The U.S. builds almost no major large commercial vessels, though new military ships do require paint.

Commercial vessel repairs in dry dock are mostly performed in countries with a comparative labor cost advantage, although currently dry dock capacity, flexibility, and efficiency are key, says Davies. Singapore and Japan together have about 40% of the dry dock maintenance and repair paint market by vessel deadweight, says Davies. South Korea, Dubai, and Portugal each have another 10%of that market. Greek and West German shipyards also do significant dry dock repair and paint work. Sea stores are set along the

Can DMSO solve your solvent problems?

Check our data base.

Gaylord Chemical can give you access to more than 15,000 abstracts, articles and patents, containing the best technical information that has been published about DMSO.

DMSO is a safer, more powerful solvent. With Gaylord's unique data base, you can find out quickly if DMSO will solve your solvent problem.

Call 800-426-6620. We'll send technical data to get you started.

P.O. Box 1209
Slidell, LA 70459-1209

CIRCLE 26 ON READER SERVICE CARD

Initially, it was a hard fight to introduce the self-polishing copolymer paints to the marine industry because of the high cost of application, says Davies. Owners had to have the hull blasted before the paint could be applied. In return they received a painted hull that could go five years between dry dock periods instead of using a paint that needed reapplication each year or two. They also saved about 12% in fuel costs because the hull remained free of barnacle-produced drag. The savings, says Davies, more than paid for the additional application costs.

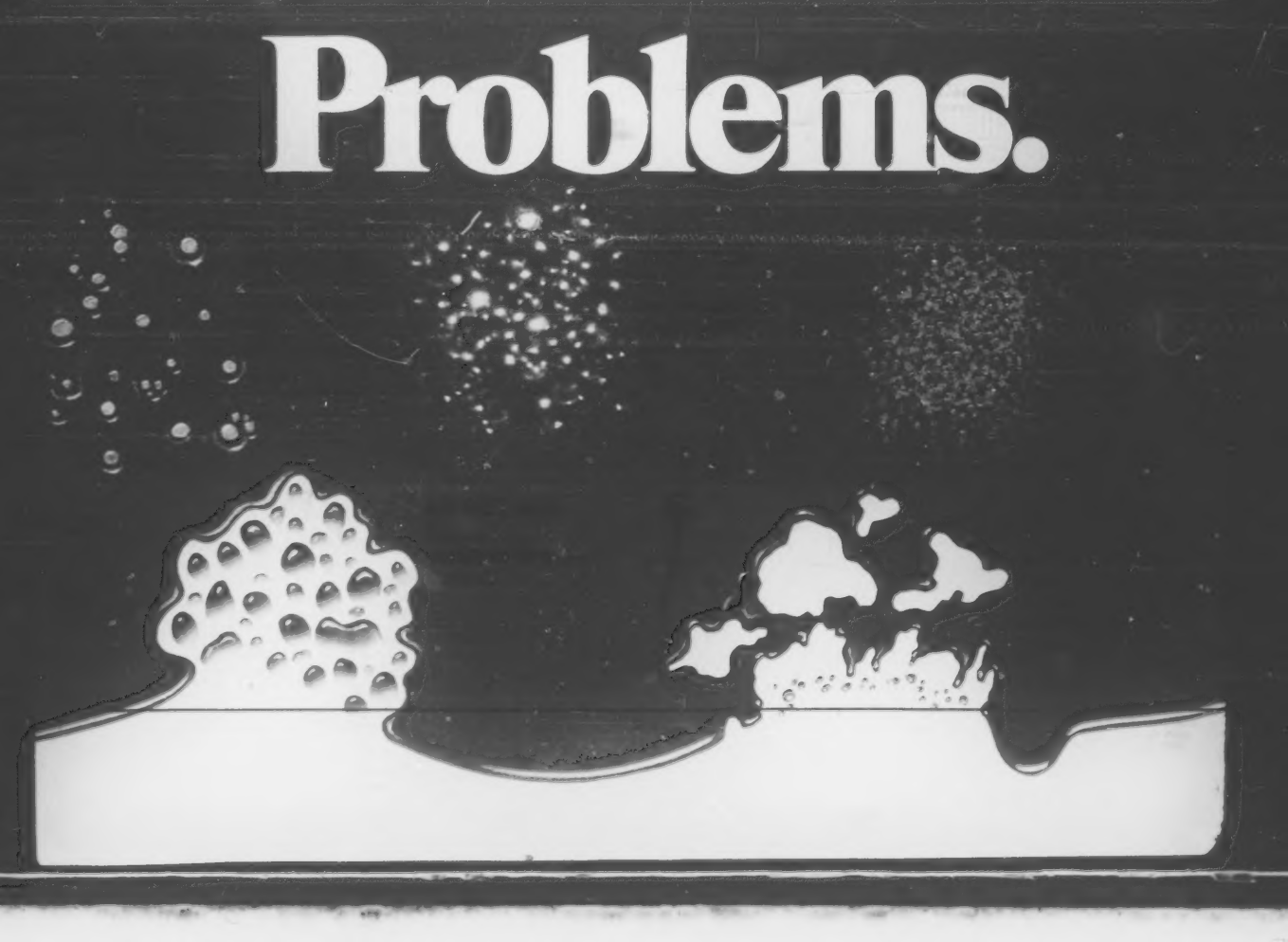
Substitutes for TBT are already available, says Davies, but they are more expensive. One is Courtaulds' Interclene BRA 500 series, which has been available since 1986 and is already in use on over 200 U.S. Navy vessels plus over 100 commercial ships. The paint is effective because of what Davies calls a controlled depletion polymer technology. Another Courtaulds hull paint, Interviron, only available outside the U.S., is TBT-free, but where the TBT-containing paint gives five years of service between dry dock spells, Interviron allows only three years and only 75% of the vessels remain virtually clean of barnacles as opposed to 96% of vessels painted with Courtaulds' TBT-containing paints.

Above-water-line coating systems vary, says Davies, and include alkyd, chlorinated rubber, epoxy, and polyurethane systems. Courtaulds produces unique antiabrasion paints called Intershield, a modified epoxy coating for decks and cargo holds, says Davies. Another recently introduced epoxy-type ballast space paint, the Intergard KB 400 series, can withstand 25 years under the wet-dry conditions it must endure, he says.

Courtaulds supplies VOC-compliant coatings worldwide, says Davies. But legislation expected in other world port markets will require that Courtaulds bring the low-VOC technology worked out in the U.S. to European ports as needed, he adds.

Jotun, the Norwegian marine coatings supplier, also manufactures a TBT-free ablative paint it calls Hydroclean, says Paul De Vivo, general manager of Jotun Valspar marine coatings. Jotun products are manufactured and distributed in a joint venture in the U.S. with Baltimore-based Valspar. Hydroclean, says De Vivo, contains cuprous oxide and allows 30 months between dry docking periods. De Vivo says a number of longer acting antifouling paints are under development, but none are yet registered and approved for use by the EPA.

Valspar, explains De Vivo, is the exclusive U.S. licensee of Jotun. The 1986 arrangement between the two helped expand Valspar's own marine paint business when, in 1984, it acquired Mobil's marine paint business and, in 1986, Beatrice's marine paint division, Farboil.



world's major ocean trade routes. Davies says Courtaulds has about 200 marine paint distribution points worldwide and paint factories in 35 countries.

Further emphasizing the international nature of the marine paints business, Davies notes in shipbuilding, for example, a Norwegian ship operator may commission a ship to be built in South Korea using Swedish, British, or American consultants each influencing the paint decisions. "If you are not an international player, you're not in the market," Davies says. Other major world marine paint suppliers are Sigma, a division of Petrofina of Belgium; Hempel of Denmark; and Jotun of Norway. Two Japanese companies are major marine paint suppliers: Chugoku and Kansai. Davies estimates that, together with Courtaulds, these companies supply about 70% of world marine coatings.

Davies says the current move by government authorities to eliminate tributyl tin (TBT) compounds from below-the-waterline marine antifoulant paints has forced Courtaulds and others to find new biocides and polymer solutions. Legislation in the U.S., Canada, Europe, Australia, and Japan effectively bans the use of the compounds on vessels less than 25 meters in length. In addition, current legislation in North America and Australia limits daily TBT releases into the sea from paint systems to 5 μg per sq cm and 4 μg per sq cm, respectively. "That is not overly restrictive. We can formulate to that," says Davies. But only the state of Virginia has water-quality legislation that limits TBT even further, effectively banning the use of the compound on ships in coastal waters.

Governments in Japan, Hong Kong, and Europe are also discussing further TBT-restricting legislation, says Davies. "Our view is that legislation to restrict or ban TBT compounds will come in another two to three years," he says. In defense of the use of TBT-containing paints such as Courtaulds' Intersmooth SPC, Davis points out, is the fact that TBT bonds to make a copolymer in the paint that slowly erodes, allowing a controlled release of the barnacle-fighting compound.

Demand for paint chemicals to grow 5.7% by 1993

$Millions	1993	1989	% annual growth
Synthetic resins	$2225	$1570	7.2%
Pigments	1750	1234	7.2
Solvents	755	813	−1.5
Additives	355	252	7.1
Extenders & fillers	220	163	6.2
Natural oils & resins	165	123	6.1
Other paint chemicals	180	131	6.6
TOTAL	**$5650**	**$4286**	**5.7%**

Source: Freedonia Group

PRODUCT PROSPECTUS

PFANSTIEHL

We've added something new: Thioglycosides.

Thioglycosides are a convenient source of the glycosyl donors needed for complex carbohydrate synthesis. They are highly crystalline and stable to a wide range of blocking/deblocking conditions. Thioglycosides can easily be converted to glycosyl halides for use under Koenigs-Knorr conditions or activated directly with a variety of reagents. Stereochemical control of the newly-formed glycosidic bond can be achieved by the appropriate group on C-2. Data sheet available.

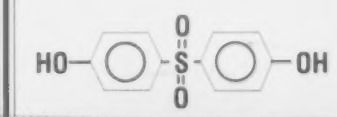
PFANSTIEHL LABORATORIES, INC.
The source for carbohydrate chemistry
1219 Glen Rock Avenue Waukegan, IL 60085-0439
Tel. 1-708-623-0370 Toll Free 1-800-383-0126
FAX 708-623-9173 Telex 25-3672 Pfanlab
70-P

MAKING THINGS WORK

CIRCLE 40 ON READER SERVICE CARD

Nachem Has It Now

DIPHONE®
(4,4'-DIHYDROXYDIPHENYL SULFONE)



GRADES AVAILABLE
DIPHONE D...99.5%
DIPHONE A...95.0%
DIPHONE C...90.0%

PERCENTAGE MINIMUM as 4,4'-ISOMER

YORKSHIRE
Yorkshire Nachem Inc.
25 Garden Park Braintree, MA 02184
Tel. 617-848-1986 (within MA)
Tel. 1-800-622-4361 Fax. 617-848-7612

CIRCLE 54 ON READER SERVICE CARD

Melting points determined easily and accurately

MEL-TEMP® II provides precise capillary melting points to 500°C. Patented 'dry' design eliminates the maintenance, temperature limitations, and hazards of hot oil. Precision lens and high intensity light provide excellent sample viewing. Digital version displays temperature to 0.1°C and improves accuracy by eliminating thermal lag.

Order factory-direct: Mel-Temp II with digital thermometer $576.00. Mel-Temp II with mercury thermometer $361.00. Mel-Temp II without thermometer $325.00. Brochure upon request.

LABORATORY DEVICES, Inc.
Box 6402-A, Holliston, MA 01746-6402
Tel. 508-429-1716, FAX 508-429-6583

CIRCLE 32 ON READER SERVICE CARD

Aside from TBT concerns, VOCs are becoming increasingly important, says De Vivo, particularly in the San Francisco Bay Area and in other localities. VOC concerns have also helped push waterborne coatings in the marine market where new formulas can offer the same or improved performance characteristics, he adds. Jotun Valspar plans to introduce a new high-performance, water-based enamel line of paints to replace alkyd formulations in signal and marine colors. The new line does not yet have a tradename, notes De Vivo, but the new water-based primers and top coats have been tested for exterior use, and will perform well on internal applications. Valspar's industrial maintenance coatings division had developed these newest coatings, points out De Vivo.

Another product from its industrial maintenance arsenal, says De Vivo, is a line of oil-tolerant epoxy coatings called Vepok. The epoxy mastic can go over oil-fouled damp surfaces and provide either a nonskid or smooth finish for use on interior surfaces. It has proved itself in refinery and other industrial applications, he adds.

Shipboard use of urethane-type coatings is growing, says De Vivo, but at a slower rate than in industrial maintenance markets. He believes resistance to their use in marine markets is due to the cost of these formulations relative to the cost of epoxys, alkyds, and chlorinated rubber, and also to the complexity of application.

Japan's Kansai Paint boasts $85 million in worldwide annual sales of marine paint, according to S. Nishimura, marketing manager, for the Kansai Paint America operations. The company is also grappling with the TBT issue. Nishimura says, "TBT compounds are positively expected to be banned in Japan within the year." Kansai is prepared for this eventuality and is about to introduce a new antifouling paint called Nu Current, a "TBT-free, water-soluble acrylic polymer." Nishimura adds that the new paint will provide commercial vessels with 30 months' or more service life between dry dock periods but "is 20 to 30% more expensive than existing organotin-compound-containing products."

Kansai is researching new "natural" solutions to antifoulant paint technology, says Nishimura. "We have spent the last 10 years studying such things as thrombosis in human beings, the skin of sea animals, and the surface energy of plant leaves to develop and perfect our nontoxic foul-release coatings technology, the 'Biox' system." Biox is currently in use in the power-generating industry and is being introduced to the marine market.

Chugoku, which markets in the U.S. as CMP Coatings division of Chugoku Marine Paint, has a new antifoulant paint that does not con-

Solutions.

3M

See us in Booth #1837 at the Paint & Coatings Show. CIRCLE 33 ON READER SERVICE CARD

tain TBT compounds. Bioclean, says Jeffrey McKenna, general manager of industrial coatings for CMP, is a polysiloxane silicone currently used in the power industry that could also be used on oceangoing vessels except for its high cost. It is, however, being tested on Coast Guard vessels. But because it cannot be applied thickly, Bioclean is effective only two years, as opposed to TBT-containing paints with their five-year maintenance cycle.

Bioclean is a new twist on self-polishing surface coatings, says CMP's Kevin Casey, general manager of marine coatings. Where TBT-containing polymers slowly wear away and thus release the TBT antifoulant, Bioclean is a slippery coating with a surface tension lower than glass. If a microorganism attaches itself, a water flow rate of only 5 feet per second will clean off anything that attaches to the paint, he adds.

Casey says CMP also offers a line of TBT-containing compounds that meet current EPA requirements for use. In addition, CMP offers a line of service-tolerant epoxy coatings and tank coatings for product carriers. Chlorinated rubbers are popular for marine use, says Casey, because crews can touch up paint easily with them, but the manufacture of chlorinated rubbers is "not environmentally friendly." As a result, they will not be manufactured as widely. Costs are already increasing for these resins.

McKenna says an alternative for chlorinated rubber is CMP's Superbondex, an epoxy urethane coating containing between 82 and 86% solids, and which is VOC compliant. It can be painted over most existing substrates with a minimum of surface preparation. While the cost of Superbondex is currently higher per gallon than the chlorinated rubber products they replace, Casey says the cost per square foot of Superbondex is about equal to chlorinated rubber paints.

Casey says Chugoku supplies its marine paints from 53 locations in 32 countries worldwide and manufactures not only in New Orleans, but also in other countries such as Brazil, Japan, South Korea, Singapore, Taiwan, and the Netherlands.

While the big marine coatings suppliers have a broad array of coatings for large ships as well as small boats, Glidden, an ICI company, supplies only pleasure craft manufacturers. It supplies a neopental glycol isophthalic-type gel-coat for fiberglass-hulled craft that provides good gloss retention, water resistance, and good patching, says Alan W. Allen, vice president. It also supplies a proprietary resins system called Blister-Gard that can be applied to a fiberglass substrate thus reducing the problem of osmotic blistering on large pleasure craft that remain in the water for extended periods.

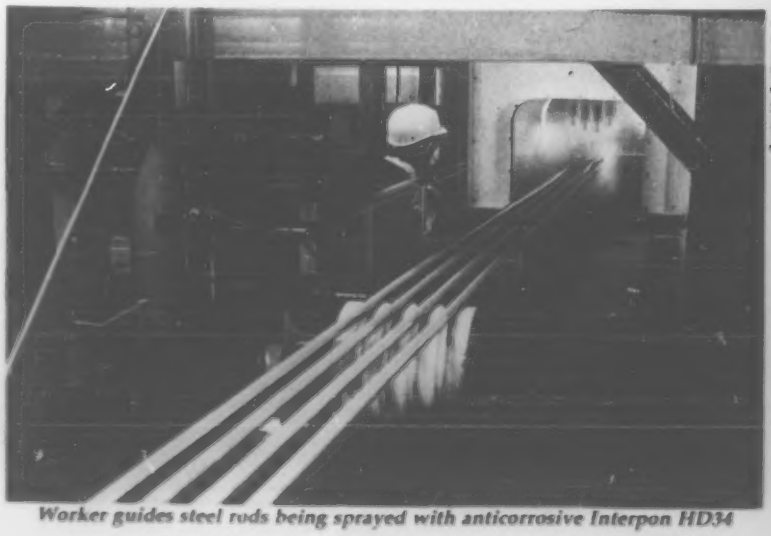
The U.S. government-supported Naval Research Laboratory in Washington, D.C., is proposing a possible high-tech solution to the antifoulant paint problem without resorting to TBT. According to Ron Price, a biologist with the lab, his colleagues at the lab, Paul Yager and Paul Schoen, discovered they could produce microcapillary organic tubules less than 1 μm across and 0.5 μm in diameter by dissolving certain lipid molecules in alcohol with the addition of water.

Price has been working with the tubules, which can absorb compounds such as the antibiotic tetracycline or copper compounds when placed in a slurry of those substances. When the tubules are then incorporated as a filler in a marine paint at the rate of 5% by volume, they slowly leach out the tetracycline, copper compound, or other slurry material. Price says he is examining natural marine proteins such as a coral extract, leptogorgia, as possible slurry compounds. He is working in association with Duke Marine Laboratories and researchers at the University of Hawaii.

Cost of the tubules is high, admits Price. The lipids to make the tubules cost about $5000 per lb, which would net 10 to 12 lb of metallized tubules. But Price believes the cost could drop when the tubules are made in sufficiently high volume. The Naval Research Lab is now looking for a commercial partner, he says, and has held preliminary discussions with International Paint, Hempel, and Nippon Fat & Oil.

One materials supplier that is eager to see more urethane used in marine coatings is Bayer. According to R. Dale Baker, director of sales and marketing for Mobay, Bayer's U.S. chemical operating arm, urethanes are used in marine environments primarily where aesthetics, arbrasion resistance, and weathering abilities are important. Two-part urethane systems are the norm in marine use, he says, with polyester urethanes in widest use. But the newer acrylic urethane systems offer the highest level of abrasion resistance and show the greatest promise for increased use in marine markets.

Rohm & Haas' David M. Watson, marketing manager for maintenance



Courtesy Coatings photo

Worker guides steel rods being sprayed with anticorrosive Interpon HD34

and specialty coatings, says the urethane polyols materials his company supplies to urethane acrylic paint manufacturers are part of a "premiere urethane top coat system used over an inorganic zinc primer," in above-waterline marine use. Where a user may be unwilling to apply a urethane, Rohm & Haas can supply a paint maker with its Maincoat HG 54 acrylic thermoplastic emulsion. The water-borne emulsion has been used in industrial maintenance paints and is now being used for marine applications. Rohm & Haas also has a solvent-thinned acrylic resin to crosslink with an epoxy now under development for use in marine environments to compete with urethane coats, adds Watson.

According to another material supplier, M. Anthony Johnson, who is market development manager for marine and maintenance at Dow Chemical, alkyds, chlorinated rubber, and vinyl are all slated for a decline in use in marine environments. Dow supplies marine coating formulators with epoxy and polyurethane materials as well as some vinyl esters. Alkyds and vinyls are under pressure because these solvent-thinned formulas have VOC problems, says Johnson. In Europe, vinyl resins have been widely used for years, he adds, but only 26% of a vinyl paint contains solids, while the remaining 74% is composed of volatile compounds. In contrast, epoxy resins, which Dow supplies, are generally incorporated into marine paints as 60% solids and allow paint makers to achieve very low VOC output.

Johnson estimates that of the total 50 million lb of resins used in the marine market annually, 16 million lb is thermoset polyurethane or epoxy resins. While use of the latter two resins is growing annually at 1.5%, he says, the overall market for marine resins has been declining at an annual rate of 2.4%. He predicts the use of vinyl resins will show a 34% annual rate of decline between 1988 and 1993, with an estimated 6.3 million lb of vinyl resins used in the marine market in 1988 declining to 800,000 lb in 1993.

Du Pont, a supplier of chlorinated rubber to the marine market, admits that use of chlorinated polyolefin resins will decline both because of price increases and ozone depletion problems associated with the resins' manufacture. According to John D. Pomije, Du Pont market development manager, coatings and resins, Du Pont has introduced the CP 100 series, a family of chlorinated ethylene vinyl acetates with a lower chlorine content. Some resins within the CP 100 series are direct drop-ins for chlorinated rubber, says Pomije. The CP 100 series contains less that 1% carbon tetrachloride, the ozone-depleting component in chlorinated rubber resins, he points out. He expects Du Pont will entirely eliminate the carbon tetrachloride content in the CP 100 series.

Johnson: alkyds, vinyls under pressure

To meet VOC concerns, Du Pont is also developing its chlorinated ethylene vinyl acetate chemistry for use in latex formulations. "It's a high priority program for us," he says. The use of this chemistry in acrylic latex formulation could lead to improved moisture-resistant coatings, he believes. In other developments, Du Pont is working on low-molecular-weight chlorinated polyolefins for incorporation in modified high solids, urethane, and low-VOC epoxy paint systems. The improvement would allow for greater adhesion, flexibility, chemical resistance, and barrier properties, notes Pomije.

Du Pont has still another contribution to the marine paint market. Although it introduced its fluoro-

INTRODUCING

High Purity MTBE

HP-MTBE (High Purity Methyl Tertiary Butyl Ether) is a new solvent providing the following advantages:

- **Typical Purity of 99.9%**
- **Resistant to Peroxide Formation**
- **Strong Solvating Power**
- **Clean Phase Separation in Aqueous Systems**
- **Good Oxidative Stability**

Experience the difference HP-MTBE can make on your various applications. Write to ARCO Chemical, 3801 West Chester Pike, Newtown Square, PA 19073, or call

1-800-345-0252.

ARCO Chemical

CIRCLE 47 ON READER SERVICE CARD

chemical additive into the consumer paint market last year for water-resistant outdoor paints, it now says the polytetrafluoroethylene Teflon additive can help produce marine antifoulant coatings. According to Dave D. Silliman, sales and development representative in Du Pont's Polymer Department, the Teflon additive provides a smooth paint surface that impedes barnacle growth. Silliman says in providing a smoother surface, the Teflon additive will also improve vessel speeds. The additive would add to the cost of marine paint, but would allow significant benefits at low loading levels. So the cost increase might be low in a market where paints sell between $100 and $200 a gal.

Powder with a purpose

While marine coating manufacturers are maneuvering to answer a host of new and expected environmentally driven limitations on the products they supply, the powder coatings market would seem to be the most environmentally friendly among reasonable-cost commercial coatings technology. Experts say the transfer efficiency of powder to substrate is on the order of 95%. And because powder is applied as a 100% solids coating, it produces virtually no VOCs. Though many marine structures are too large for the heat-curing technology required in powder coating use, pipe, underhood automotive parts, and metal furniture are ideally suited to powder coatings.

But these coatings are limited almost exclusively to metal substrates. And manufacturers who install powder coating lines generally must completely replace the liquid coating equipment they have already invested in. Further, powder users generally cannot change color on their coating lines as quickly as liquid coatings allow. Powder coatings still make up only 8% of OEM product finishes.

According to Jim Hansen, a spokesman for the Powder Coatings Institute (PCI), the high cost of equipment may once have been a barrier to painters' use of powder, but the cost of equipment has improved considerably and operating costs are comparable to, and perhaps even lower than, liquid coatings. A major impetus for the use of powder coatings is that they admit virtually no air emissions and almost completely eliminate solid waste disposal of used powder. Powder "overspray" can be filtered and recycled.

Overall growth of the powder coatings market in the U.S. has been about 25% annually between 1982 and 1989 when U.S. applicators used 107 million lb of powder, according to PCI data. The institute, made up of powder formulators, material suppliers, and equipment manufacturers, projects 1990 powder sales in the U.S. of 118 million lb and 200 million lb by 1995. Currently, the fastest growing market for powder coatings is in the appliance business, says Hansen, where 22% of all powder is currently used. General metal finishing for patio furniture, office furniture, tool boxes, industrial metal reinforcing rods, pipe linings, and other uses has about 53% of the market, he adds. Another growth market is architectural panels, already a major use in Europe, but currently accounting for only 5% of the U.S. market. Automotive uses account for another 20% of powder coatings applications.

Hans Kuenzel, an industry analyst with Freedonia Group, is also bullish on powder coatings. They can, he says, be applied to metal substrates without primers. And though the cost of upgrading equipment for powder use is a disadvantage and material costs are 8 to 10% higher, high transfer efficiencies and the elimination of almost all waste and emissions offset those costs. Should powder manufacturers be able to lower curing temperatures, powder coatings could find new opportunities in other markets such as plastics, he believes. PCI can confirm a dramatic growth in the number of powder coating suppliers. According to Gregory J. Bocchi, executive director of the institute, about 35 manufacturers and distributors operate today in North America, 22 of whom are currently members of PCI. PCI had only 14 members who were manufacturers or distributors in 1984.

Morton International's Bob Covalt, president of the specialty chemicals group, points out that

A BUBBLE BATH COULD PUT YOU UNDER.

When things bubble over in your process system, you can keep the problems from coming to a head with our silicone or non-silicone antifoams.

Our antifoams are manufactured to the highest quality standards in a wide variety of both aqueous and non-aqueous formulations. They provide fast, long-lasting action for processes ranging from oil drilling to carpet cleaning.

If you have a unique problem or process, we'll provide a custom formulation developed in our own laboratories.

And we can also supply your surfactant and emulsifier needs for products ranging from detergents to pesticides.

All our products are available for prompt delivery from our more than 35 nationwide distribution centers.

Whatever your requirements, contact our Specialty Chemical Division at 913-621-7747 or 913-621-7749.

We're your primary source for specialty chemical needs.

Your Primary Source

HARCROS
CHEMICAL GROUP

Harcros Chemicals Inc
P.O. Box 2383, Kansas City, KS 66110

547-290

CIRCLE 29 ON READER SERVICE CARD

dry clean
It slides cleanly by ultrafilter membranes. No damage. Better flow. And healthy enzyme growth.
DOW CORNING® 1920 powdered antifoam is dry. So it disperses fast. It can work in powders from fertilizers to detergents.
1920 POWDERED ANTIFOAM
1-800-FOAM-FREE
DOW CORNING
It's good news for pharmaceuticals to fertilizers. Convenient packaging. Also 30-gallon drums. Call for a free sample.
Drop a four-ounce dissolvable packet into your process. No complex calculations or equipment. No gooey containers or spills.
easy new

where the market for all coatings overall has been flat in recent years, the market for powder has shown dramatic growth. Morton claims to be the largest U.S. producer of powder coatings. Glidden disputes that claim. Since no producer publishes production numbers, opinion varies as to who is the larger.

Morton arrived at its position in powder through the acquisition of Phillip Morris Industrial, including its Armstrong Powder business. It followed with the purchase of Polymer Corp. from Chesebrough-Pond's, making Morton, says Covalt, the largest U.S. powder coatings supplier.

Covalt acknowledges that the driving force behind the conversion to powder coatings is environmental. Its direct competition is high solid solvent paint and water-borne coatings, he says. Powder, though, is recyclable, largely eliminating waste. And as users have the ability to apply a thin powder film, oven-cured powder coatings make economical and durable product coatings. Where once just a few manufacturers provided powder coatings, "even major liquid coatings formulators who were losing share of market to powder" are now producing powder coatings, he says.

Covalt says Morton supplies customers with polyester, acrylic, epoxy, and nylon powder coatings under its Corvel tradename. The company is backward integrated in the manufacture of polyester resins for powder coatings as it also has a considerable business in the adhesives and sealants business with this resin. Most of the coatings are used in decorative applications such as for metal furniture; lawn and garden equipment; vending machines; and even heating, ventilation, and air-conditioning units for which powder can provide high-grade durable finishes and even thick finishes for corrosion protection.

Covalt says some of Morton's epoxy coatings are supplied for use on steel concrete reinforcing rods, or rebar, as well as steel pipe interior coatings. Covalt acknowledges 3M is strongest in this industrial functional applications business. He points out, however, that the decorative coating market for powder is a $300 million market while that for functional coatings is only $75 million.

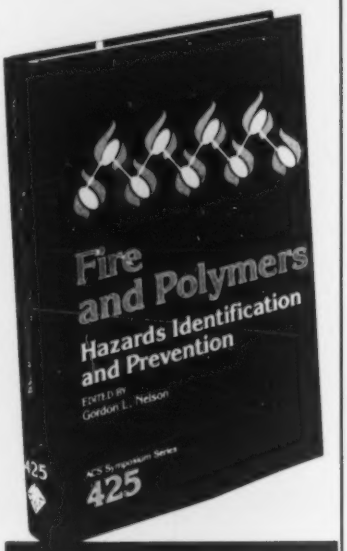
To date, though, Covalt figures powder probably has only captured about 10% of the market it is eventually likely to capture. "So you can see there is plenty of room for growth," he says. One large market Morton is hoping to see is powder used as an automotive exterior body coating in addition to its use on under-the-hood parts in which powder is already established.

To develop a larger market for automotive powder coatings, Morton has established a new technical service center in Rochester Hills, Mich., to service nearby Detroit auto and automotive parts manufacturers. In addition, Morton recently acquired Whittaker Coatings, a strong player in the liquid coil coatings market. Combined with the Bee Chemical business it also acquired recently, Covalt points out that Morton has a large presence in the automotive market. He says Morton's coating sales is now a $300 million business annually.

Glidden vice president Allen says his company has been involved in powder coatings since the early 1970s. Now that the market for powder in appliances, automotive, and select metal industrial areas is growing, Allen says Glidden is "pleased we stayed there during the lean years." He notes that the powder coatings business has grown from a small base to become a high-performance, low-VOC technology with year-to-year growth rates of at least 12% that continue to make it an attractive business to be in. To fuel further dynamic growth, replace liquid coatings, and increase market share, powder needs a major advance in other large industrial applications. This might be in clear powder top coats, primer surfacers, and antichip coats for automotive body exteriors.

Glidden supplies a full range of powder coatings including epoxy, epoxy-polyester hybrids, polytetraglycidal isocyanate (TGIC), acrylics, and polyester urethanes, says Allen. In addition to metal containers for beer, beverages, and foods, Allen is looking to the use of powder on nonmetallic substrates once lower temperature cures are achieved.

CIRCLE 22 ON READER SERVICE CARD



Fire and Polymers

Hazards Identification and Prevention

Presenting a representative segment of the latest research in the field, this 34-chapter book offers valuable information on the combustion of polymeric materials. Five sections cover the following critical concerns of fire and polymers:

- fire toxicity
- fire retardants and fire-retardent commodity plastics
- fire retardancy in engineering plastics
- fire and cellulosics
- fire performance, testing, and risk

This unique volume contains contributions from sources as diverse as the Center for Fire Research of the National Institute of Standards and Technology, the Swedish National Testing Institute, the USDA Forest Products Lab, as well as major universities all over the world.

Product developers, managers, regulators, and scientists involved in fire research will find *Fire and Polymers* of vital importance.

Gordon L. Nelson, *Editor,* Florida Institute of Technology

Developed from a symposium sponsored by the Macromolecular Secretariat of the American Chemical Society

ACS Symposium Series No. 425
640 pages (1990) Clothbound
ISBN 0-8412-1779-3 LC 90-34195
$99.95

O·R·D·E·R F·R·O·M

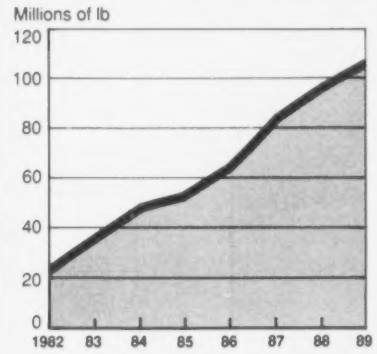
American Chemical Society
Distribution Office, Dept. 70
1155 Sixteenth St., N.W.
Washington, DC 20036

or CALL TOLL FREE

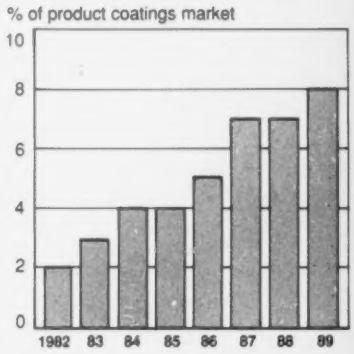
800-227-5558

(in Washington, D.C. 872-4363) and use your credit card!

Powder coatings up about 25% annually since 1982 . . .



. . . but are still under 10% of product coatings market



Note: Coatings use as reported by original equipment manufacturers. **Sources:** Bureau of the Census, Powder Coatings Institute, C&EN estimates

Courtaulds Coatings claims to be the "largest and leading powder coating supplier worldwide," says Richard J. Higgins, general manager of the powder coating services group, supplying a broad array of powder coatings under its Interpon tradename including epoxy, epoxy-polyester, and TGIC.

Worldwide, says Higgins, powder coatings have been growing 12 to 15% over the past four to five years. The U.S. didn't seem to exploit the use of powder coatings widely until about five or six years ago. People, he adds, did not seem to expect powder to perform for the long term then. But in Europe, where the environmental advantages of powder were realized much earlier than in the U.S., powder took off, particularly in the U. K. and in Italy, he says, where many coatings applicators were installing new automated lines.

European growth has been dramatic. Where five years ago powder represented about 8% of industrial coatings as a percentage of dry film on the surface of a component, that figure reached 15% in 1989. By 1994, Higgins forecasts that number will reach 18%. In North America, Higgins figures that powder as a percentage of dry film on OEM components was 7% and should grow to 12% by 1994.

One technology for powder coatings that has been developed in South Korea and Japan, and is just being developed in Western Europe and North America, is powder coating of metal blanks. Uncoated metal coil for use in the manufacture of domestic appliances is cut into blanks, to which powder is applied on all surfaces including edges, says Higgins. Once the metal is cured in an oven, it is then folded into shape yielding a metal form that is completely coated, says Higgins.

Another metal coatings market that shows promise to develop further in the U.S. is powder for architectural metal panels. It is more widely used now in Europe than in the U.S., says Higgins. But as powder becomes more widely used in the U.S., that situation should change, he notes.

Powder coating for plastic substrates is under development, says Higgins. Some plastics are now being coated through an in-mold powder coating technique. Also the new generation of high-temperature, high-performance engineering plastics can be powder coated. But current powder coating curing temperatures limit use for general-purpose coatings of plastics, he adds.

However, powder coatings may be applied to more than metal and certain plastic substrates. They may also be applied to glass, roof tiles, and ceramic and clay flower pots. "I don't see an absolute limit to the substrates which powder can coat," says Higgins.

According to Lars Carlson, vice president and general manager of industrial coatings for H. B. Fuller,

new powder products are coming into the market constantly. He confirms Higgins' observations that "everyone" is working on applying powder to plastic substrates, and some manufacturers offer powders for in-mold coatings of plastics. Fuller, he says, offers an array of powder coatings including polyesters, urethanes, and hybrids. To keep up with industry growth, Fuller will add a new powder production line in its Chicago facility within the next nine months "in order to handle forecast demand increases," says Carlson. PPG, a supplier of liquid coatings, has more recently become involved as a supplier of powder coatings. Demand for powder coatings depends heavily on environmental pressure, says Gregory C. Wagner, marketing manager of industrial coatings. "Our mission is to sell what the customer needs," says Wagner, citing PPG's ability to supply electrodeposition, high solids, water-thinned, and radiation-cured coatings as well. PPG supplies a number of powder types from resins it manufactures including polyester, epoxy, acrylics, and hybrids under its Enviracryl tradename. Applications are mostly for decorative metal surfaces.

However, PPG has begun supplying some powder coatings for plastic substrates. Wagner says the company has been selling powders for sheet-molding compound, a fiberglass plastic composite widely used for automotive body panels, for about a year. "We have powder products that cure at temperatures as low as 250 °F," he says.

According to Debra E. Gill, national product manager for the powder coatings division of O'Brien Corp., manufacturer of Fuller O'Brien paints, powder coatings will continue to improve with thin, smooth films achieving extended weatherability. Developments are continuing in powder coatings for plastic components and "possibly wood where low-temperature powder coatings will be employed." She adds that "conductive coatings are on the horizon."

3M's Scotchkote powder epoxy powder coatings business is aimed at markets for pipeline and reinforcing steel protective coatings. Its Scotchcast powder epoxys are formulated for use as electrical insulation for products such as motor stators and armatures. It had been involved with powder coatings for 30 years when, says Tom McDonnell, program manager for the electrical products division, "3M pioneered the development of fusion epoxy resins as pipe coatings." Today, 3M's epoxy powders "fit most every need in the functional coatings area. By design, 3M does not participate in the decorative resin market," he adds.

Domestic growth of 3M's powder business depends on the business cycle in the pipeline industry and in structural and reinforcing steel "if federal and state highway construction funds are available," says McDonnell. He admits 3M has not been as forward with its epoxy powders outside the North American market, and, as a result, "expects the majority of its growth to be in foreign mar-

To Reach The Top Of The Fine Chemicals Industry, We Started At The Base.

How did Nobel Chemicals get to be a world leader in Nitration and Nitric Acid Oxidation?

By continually expanding our base technologies. By providing complete programs from synthetic design to custom manufacture. And by perfecting "forward integration"—environmental, quality and cost control from raw material to intermediate to end product. In short, we became a world leading chemical supplier by doing what we do best. Creating pure chemistry.

Call or write Nobel Chemicals for more information on these base technologies:

Nobel. Pure Performance. Pure Chemistry.

Nobel Chemicals
Nobel Industries Sweden

Please contact:

U.S.
Nobel Chemicals, Inc.
1530 Valley Center Parkway
Suite 110
Bethlehem, PA 18017, USA
Phone: (215) 866-4100
FAX: (215) 867-4577

Outside of U.S.
Fine Chemicals Division
S-691 85 Karlskoga
Sweden
Phone: 46 586 83000
FAX: 46 586 32147

CIRCLE 37 ON READER SERVICE CARD

kets where this proven technology can be adapted locally."

American Cyanamid, a material supplier to powder coatings formulators, says it has a new amino crosslinker that may well yield a new class of lower cure powder coatings than now exist. It has been gearing up to produce its Powderlink 1174, says Charles Van Fleet, resin products department project manager, commercial quantities of which will be available in the fourth quarter of this year. Conveyors and flakers are now being installed at Cyanamid's major amino resins plant in Wallingford, Conn., to handle and isolate the amino solids needed to manufacture Powderlink 1174. Van Fleet could not say what actual capacity of the resin would be, but said that Cyanamid would be able to supply "hundreds of thousands of pounds."

Powderlink 1174 is partly an answer to toxicity concerns with TGIC powder coats as they cure. It also provides an economic incentive for users in that they will be able to formulate a coating using hydroxyl rather than carboxyl polyester. Van Fleet says Powderlink 1174 has a formaldehyde level below 0.1%, and notes, "the predominant product of reaction is methanol." Using the new product would lower powder coatings raw material costs 15 to 20%, says Van Fleet.

In addition, Cyanamid has isolated a new catalyst, methyltolylsulfonimide (MTSI) for use in conjunction with its Powderlink resin for high-gloss films. However, that product is not commercially available. Van Fleet, though, says Ruco Polymer Corp., formerly part of Occidental Chemical, manufactures a polyester resin that contains catalyst functionality and can provide powder coatings manufacturers with a product whose exterior durability is competitive with current top coats and can compete in appearance with urethane-type coatings. Van Fleet believes that powder coatings containing the new Powderlink product will find their way to the general industrial applications market including patio furniture, office furniture, appliances, and even architectural coatings.

Another material supplier taking aim at TGIC's toxicity problem is Rohm & Haas. According to Herb Pigrom, powder coatings market manager, his company has introduced a new crosslinker, Primid XL-552. He describes it as a hydroxyalkamide that together with a carboxyl polyester resin will yield a very durable resin. Rohm & Haas claims powders manufactured using its new crosslinker will have better hardness, and scratch and detergent resistance than current powders.

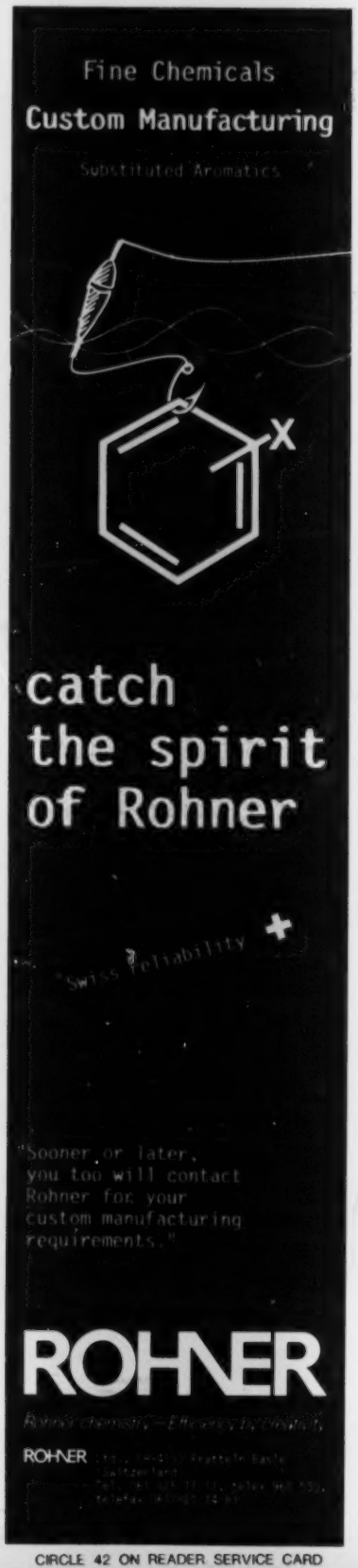
Dow Chemical's Kip Thomson, powder coatings marketing manager, says his company is a major supplier of epoxy resins and phenolic hardeners for powder coatings producers. He believes epoxy hybrid powders are faster growing than straight epoxy formulas. Among resin systems, he ranks hybrids such as epoxy-polyesters first, followed by TGIC, polyurethane, and straight epoxy systems. Dow plans to commercialize an epoxy resin for use in conjunction with a polyester, with the experimental designation of XU 71863.01 within the next few months, he says.

Michael Chovan, specialty products manager for carboxyl and hydroxyl polyester resin producer Cargill, says his company is helping customers to develop clear powder coats for doors, faucets, and kitchen sinks, among other applications. However, he believes the business slowdown now under way will slow powder sales growth overall in 1990 to 10 to 12% for the year.

Paint disposal issues loom

While powder coatings boast minimal waste produced in the applications process, all liquid-applied spray coatings are subject to transfer efficiency limits of 50% at best. Used in an industrial setting, the overspray clogs grates, interferes with spray booth airflows, and must be separated and disposed of. These problems may argue for greater use of alternative technologies like powder. But because of the heavy investment in liquid spray technology, its long-term proven performance, and the work of water treatment companies, overspray is becoming less of a problem.

In fact, sludge captured from

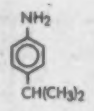


CIRCLE 42 ON READER SERVICE CARD

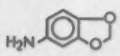
Organic Intermediates

for pharmaceuticals, agrochemicals, dyestuffs, flavors, fragrances, photochemicals, etc.

4-Isopropylaniline
(4-Aminocumene)

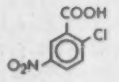


3,4-Methylenedioxyaniline
and N-Ethyl derivative



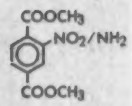
2,3-Benzofuran
(Coumarone)

2-Chloro-5-nitrobenzoic acid

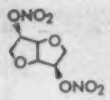


3-Nitrobenzaldehyde

Nitro-/Aminoterephthalic acid dimethyl ester



ISDN
Isosorbide dinitrate,
mixtures with lactose, etc., USP XXI



US-Agents:
Henley Chemicals, Inc.
50, Chestnut Ridge Road, Montvale
NJ 07645, Phone (201) 307-0422
Fax (201) 307-0424

▲ 120.0.527

EMS

EMS-DOTTIKON AG
CH-5605 Dottikon, Switzerland
Phone 057 26 11 55
Telex 827 923, Telefax 057 24 21 20

formerly SSF DOTTIKON

CIRCLE 24 ON READER SERVICE CARD

paint overspray is an issue the water treatment companies and their customers are attempting to deal with before legislation forcing a solution comes into effect. After all, the industry only has to follow the crazy quilt of varying nationwide VOC standards to see what can happen when government gets involved with imposing solutions. In the case of overspray clean-out and subsequent careful sludge disposal or recycling, economic efficiencies require both more efficient spray booth operation and disposal techniques that will not come back to haunt waste generators.

According to Ed Kliff, vice president of chemical industry consultants Phillip Townsend Associates, the current size of the market for chemicals, emulsions, and services to treat paint overspray is about $50 million. It is potentially at least four times as large and perhaps many times larger when industrial spray booth operations other than automotive, the largest segment, are added in, he says.

Chuck Zuerner, market development manager for Nalco's HEC Management Services, says aside from the automotive paint overspray market, paint overspray treatment markets could also include aircraft or bicycle wet spray paint lines. Anyone who operates a wet spray booth could benefit from Nalco's water treatment chemistry, he notes. Nalco is now promoting its management services in which HEC supervises the treatment of overspray in the booth, its clean-out and disposal. Nalco's people are at the spray booth site full time, says Zuerner, supervising the addition of the company oil and water emulsion in the paint spray booth water.

Nalco's HEC Services contracts with RTR's vacuum trucks to remove its sludge and haul it to an RTR facility where a Nalco-supplied oil is separated from the sludge and reclaimed for later use and the solids are supplied to cement kiln operators as a filler and fuel supplement. Ash from the paint pigment fuses with the cement aggregate to form a neutral filler, says Zuerner. "Our niche is with companies who were landfilling their paint sludge as a hazardous waste." Other benefits are a cleaner spray booth and reduced clean-out labor, adds Zuerner.

Zuerner says the HEC system also requires a closed system to preclude overflow of toxic organics in paint into municipal sewer systems as well as a mist elimination system to reduce residual spray solids that could be vented from the booth air exhausts. The mist elimination system poses benefits particularly where a spray operation may be close to a residential area. Neighbors are not too pleased with paint residue that may settle around their homes, he notes.

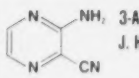
According to Jim Marcrum, director of Calgon Water Management's Interac Group, the company's new Paint Kill system offers to isolate 30 to 40% dry solids using Calgon chemistry as opposed to 15% solids in older systems. With less water to evaporate from the solids, less drying energy is required. Marcrum says the company uses all polymer chemistry to increase solids capture as opposed to other systems that use aluminum, iron, zinc salts, or bentonite clay and only then use polymers to flocculate the paint solids.

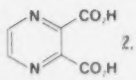
As a result of Calgon's water treatment efficiency, Marcrum says pit and plenum clean-out is greatly reduced. One customer adapted the system and was able to reduce its paint spray booth clean-out schedule from every four weeks to once every six months. Marcrum also claims the new Paint Kill system allows per-unit treatment at $1.50 while competing detackification systems cost between $3.50 and $6.00 per comparable unit.

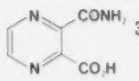
Historically the wet cake sludge is landfilled. In most cases it is not classified as hazardous, says Marcrum. But Calgon is working now with a paint manufacturer to dry the sludge to a 99% dry powder and recycle it into a paint. The dry sludge might also be used as a filler in adhesive formulations, he suggests.

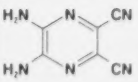
Gary A. Tonn, business development manager with W. R. Grace's Dearborn division, says his company can also offer all-polymer chemistry to isolate and detackify paint overspray in booth operations. Tonn says Dearborn's chemistry can detackify some otherwise hard to treat, low-VOC, high-solids paints. Once

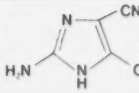
IMIDAZOLES
&
PYRAZINES

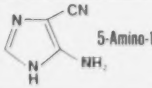

3-Amino-pyrazinecarbonitrile
J. HETEROCYCLIC. CHEM.:
26, 3, 817-819(1989)

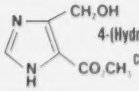

2, 3-Pyrazinedicarboxylic acid

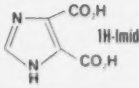

3-Aminocarbonyl-
pyrazinecarboxylic acid


5, 6-Diamino-2, 3-pyrazine-
dicarbonitrile
J. HETEROCYCLIC. CHEM.:
23, 6, 1741-1746 (1986)


2-Amino-4, 5-
dicyano-1H-imidazole


5-Amino-1H-imidazole-4-carbonitrile


4-(Hydroxymethyl)-1H-imidazole-5-
carboxylic acid methyl ester


1H-Imidazole-4, 5-dicarboxylic acid

For more information, check the reply card.

Nisso

Pharmaceutical Dept.

NIPPON SODA COMPANY LIMITED

2-2-1, OHTEMACHI, CHIYODA-KU, TOKYO, JAPAN
TEL. (03)245-6161 TELEX. 0222-2379 NISSO J

NISSO AMERICA INC.

220 EAST 42TH STREET, SUITE 3002, NEW YORK
N.Y. 10017, U.S.A.
TEL. 212-490-0350 FAX. 212-972-9361
TELEX. AAB-236136 NZA UR

CIRCLE 50 ON READER SERVICE CARD

the paint solids are isolated from the booth water, that water is "very clean," has very few suspended solids, and can be recirculated in the spray booth. "Though we supply and provide service support, the plant people generally make the chemical additions to the booth water. Though in one plant we do control the chemical treatment program," he says.

Sludge resulting from the water treatment is dried, says Tonn, and is landfilled or used in cement kiln operations. While the customer generally disposes of the sludge, Tonn says Grace's Dewey & Almy Teroson automotive experts are working with consolidated and dried paint sludge for use as an inert filler in underbody coatings and sealers including epoxy adhesives. They are in the process of scaling up a commercial process plant and have already proved that the incorporation of the sludge into these products meets test specifications. Where they use the sludge for their products, Dewey & Almy would purchase it from the paint booth operator.

Carmen Sarno, vice president of technical marketing at Betz Lab's Metchem division says his company provides customers with a complete program of polymers, antifoams, biocides, and auxilliary products for the maintenance of a clean spray booth. Most customers are in the general manufacturing and automotive business. Each customer receives a customized program to help in efficient booth operation allowing for the greatest transfer efficiency of paint spray operations. He adds that "we're spending a lot of research and engineering time on developing detackification programs for water-based paints. Our customers are all looking at it. It's coming."

Thomson: epoxy hybrids growing fast

Allen: powder on nonmetallics soon

According to Kenneth J. Lehman, business vice president of Henkel's Parker Amchem subsidiary, this large supplier of phosphate treatments for steel is now investigating systems to reduce sludge produced in the phosphating process. Phosphate sludge now either goes through a sediment filter or is skimmed off like paint sludge and landfilled as a nonhazardous waste, he says. The company is attempting to perfect treatments with as high a solids content as possible.

Parker Amchem also supplies defoamers, deflocculants, and biocides to spray booth operators, says Lehman. Here, too, the aim is to bring the solids content up as high as possible. Parker Amchem contracts with other suppliers to haul paint sludge away from its customers' operations to a landfill, but it is working on programs to recycle the sludge, possibly as a filler for a sound- deadening coating or for incineration. □